JAN MCLIN CLAYBERG
PATENT AND TECHNICAL TRANSLATION

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DECLARATION

The undersigned, Olaf Bexhoeft, hereby states that he is well acquainted with both the English and German languages and that the attached is a true translation to the best of his knowledge and ability of the German text of PCT/EP03/01290, filed 02/10/2003 and published 08/21/2003 under No. WO 03/069140 A1, and of six (6) pages of amended specification and six (6) amended claims.

The undersigned further declares that the above statement is true; and further, that this statement was made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or document or any patent resulting therefrom.

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METHOD FOR PRODUCING A COVER THAT CAN BE PLACED ON THE END OF A MOTOR VEHICLE EXHAUST PIPE, AND A COVER PRODUCED ACCORDING TO THIS METHOD

The invention relates to a method for producing a cover made of a special steel blank which can be deep-drawn and placed on the end of a motor vehicle exhaust pipe, and a cover produced in accordance with the invention.

Such covers are used as an ornamentation on the end of the exhaust pipe protruding from the rear of a motor vehicle. For this reason the non-rusting basic material, the special steel, and the appearance of the surface of the cover are of decisive importance.

As a rule, known covers of this type are bent from a special steel blank into a sleeve-shaped body and are welded together at the joint on the shell circumference. This requires a considerable outlay for labor, in particular in the course of the manufacture and finishing work for the weld seam. The result of this is that covers produced in this way are very expensive.

It is the object of the invention to provide a method of the type mentioned at the outset, by means of which such covers can be produced in one piece without welding work and without the finished cover experiencing impairments which make the cover less valuable or even turn it into waste.

In accordance with the invention, this object is attained by the combination of the following method steps which follow each other directly:

a) a circular blank (10) is made from a special steel plate,

b) a cup-shaped beaker (10.1, 10.2, 10.3, 10.4) with a bottom (11.4), which is inclined in respect to the longitudinal axis (25) and has a diameter (D1, D2, D3, D4) which is reduced in steps, and a shell length (L1, L2, L3, L4) which increases in steps, is drawn in several deep-drawing operations,

c) a centered hole (13) with a rim (14) which is ring- shaped toward the shell (12.4) is punched into the bottom (11.4),

d) the shell (12.4) is cut vertically in respect to the longitudinal axis (25) of the beaker (10.4) to the required length (Lo) and a condensate (16) and/or a fastening hole are cut into the shell (12.5),

e) the rim (14) of the bottom (11.4) is bent-in parallel in respect to the longitudinal axis (25) and is subsequently crimped into the beaker (10.6) to form an end (17) in the shape of an arc of a circle, and

f) at the finish the end section (18) on the cut open front (15) of the beaker (10.7) is tapered for decreasing the diameter.

In this connection it is crucial that these method steps are performed directly, i.e. in short periods of time, one after the other. Since the axial dimension of the cover is considerable for a deep-drawing method, the deep-drawing process must take place in several deep-drawing steps with diameters decreased in steps and a shell length increased in steps. These are followed by the method steps for forming the two open front faces of the cover,

wherein the crimped rim and the tapered end section of the cut-off shell result in the final shape of the cover by means of appropriate method steps.

In connection with one embodiment care must be taken in the method steps that the transition from the inclined bottom to the shell of the various deep-drawing steps is always rounded, so that no damage occurs, particularly in the transition area from the bottom to the shell of the drawn beaker.

Regarding the inclination of the bottom in respect to the longitudinal axis of the beaker it is provided that the bottom is inclined in respect to the shell of the various deep-drawing steps at a diameter by approximately 70°, or 110°, in respect to the longitudinal axis.

So that the front face of the cover facing the motor vehicle, and possible openings and/or holes in the shell of the beaker can be cut in a simple manner, an embodiment provides that the cutting-off of the shell to the required length and the cutting of the condensate drain opening and/or fastening hole are performed together. These method steps can be performed together, since they are performed in the same processing direction.

If it is provided that prior to crimping of the end in the form of an arc of a circle the bore in the bottom is shaved, the crimped end of the beveled front of the beaker becomes uniform.

A cover produced in accordance with the invention is distinguished in that it is embodied in one piece in a sleeve-like manner, wherein a front end, which is inclined in respect to the longitudinal axis, is provided with an end crimped in the shape of an arc of a circle, and wherein the other front end extending perpendicularly in respect to the longitudinal axis in the adjoining end section has a diameter which is less than the diameter

of the remaining shell. The crimped end provides stiffening and avoids sharp edges, while the tapered end section stabilizes the drawn cover and prevents undesired contractions of the material because of tensions occurring in the material.

The shell of the sleeve-shaped cover is provided with an opening and/or a bore, which can be used as a condensate drain or as a connection of the cover with the exhaust pipe.

The invention will be explained in greater detail by means of an exemplary embodiment represented in the drawings. Shown are in:

Fig. 1, a circular blank as the initial basis for producing a cover made of special steel,

Figs. 2 to 5, four deep-drawing processes for beakers as the pre-products with diameters reduced in steps and shell lengths increased in steps,

Fig. 6 and 7, cutting and punching the hole in the bottom of the beaker,

Fig. 8, cutting the shell of the beaker to size and cutting an opening and/or a bore into the shell of the beaker,

Fig. 9, shaving the hole in the bottom,

Fig. 10, a tool for the vertical alignment of the rim in the bottom,

Fig. 11, a tool for crimping the rim,

Fig. 12, tapering the end section of the shell,

Fig. 13, a vertical section through the finished cover,

Fig. 14, a plan view from the front end with the tapered end section on the sleeve-shaped cover, and

Fig. 15, the crimped end of the beveled front end of the finished cover in an enlarged partial view.

The circular blank 10 represented in a lateral view in Fig. 1 is produced, preferably cut, from a special steel plate which can be deep-drawn, of a diameter D1 of 190 mm, for example, and a thickness do of 1 to 1.2 mm, for example.

In a first deep-drawing process, a beaker 10.1 with an inclined bottom 11.1 is drawn by means of a deep-drawing process, whose diameter D1 = 117.7 mm, and the shell 12.1 is brought to a shell length L1. In this case the inclination of the bottom 11.1 in respect to the longitudinal axis 25 of the beaker 10.1 on a diameter is 70° or 110°, as shown in Fig. 2.

In the following second deep-drawing process, the beaker 10.2 is drawn with a smaller diameter D2 = 96.95 mm, but a greater length L2 of the shell 12.1, so that the beaker 10.1 in accordance with Fig. 1 has become the beaker 10.2, as shown in Fig. 3.

A further, third deep-drawing process follows, in which the beaker 10.2 in accordance with Fig. 3 is changed into a beaker 10.3 in accordance with Fig. 4, with a diameter D3 = 79.5 mm and a length L3 of the shell.

The deep-drawing process is ended in a fourth method step, in which finally the beaker 10.4 is created with the final diameter D4 = 68.7 mm and a length L4 of the shell 10.4 in accordance with Fig. 5. The lengths L1 to L4 result automatically, since the initial circular blank 10 is defined.

As Figs. 6 and 7 show, the slide is trimmed with a clipping punch 20 and a centered hole 13 is punched into the bottom 11.5 with the punch 30, so that an annular rim 14 remains around the hole 13.

Fig. 8 shows a cutting tool 40 and a punching tool 50, by means of which the length Lo of the shell 12.5 of the beaker 10,5 in accordance with Fig. 7 is shortened to the required length, wherein the resultant front face 15 is oriented perpendicularly in respect to the longitudinal axis 25 of the beaker 10.6. An opening 16 and/or a bore are punched into the shell 12.5, wherein cutting of the shell 12.6 and punching of the diameter 16 and/or the bore can occur simultaneously, since both work directions of the processes are the same.

As Fig. 9 shows, the bore 13.1 can be shaved in order to position the rim 14.1 uniformly around the shell 12.5 of the beaker 10.6.

Initially, an area of the rim 14.1 adjoining the hole 13.1 is crimped parallel with the longitudinal axis 25 of the beaker 10.6 by means of the two tools 50 and 55 and is thereafter shaped in the form of an arc of a circle by means of tool 60 and 65. In this case the tools 60 and 65 are matched in the form of a semicircle in the facing corner areas, as shown in Figs. 10 and 11.

As Fig. 12 shows, the finished front end 11.5 of the beaker is held by the tool 65, and a tool 70 tapers the end section 18 in the area of the cut-off front face 15 in such a way that the diameter of the cover 10.7 in this area is reduced. In the process, the cover 10.7 is supported in the receiver 19 of the tool 70. The crimped end 17 in the area of the front face 11.6 not only prevents sharp edges but, together with the tapered end section 18 of the shell 12.5, it is used for stabilizing the shaped cover 10.7, so that tensions caused by tensions

in the material cannot result in an uncontrolled contraction of the material and impairment of the surface of the cover 10.7.

It is possible in this way to produce in a cost-effective way and without worsening the shining surface a one-piece cover 10.7 from a special steel circular blank 10 in Fig. 1, which is made of a material which can be deep-drawn, as shown in Figs. 13 to 15.

Here, Fig. 13 shows a vertical section through the finished cover 10.7 with the crimped drain 17 on the inclined front face 11.6, with the hole 13.2 and the tapered end section 18 at the cut-off front end 15. The sectional view also shows the wall thickness of the cover 10.7, which is obtained by means of a material which is approximately 1 to 1.2 mm thick, but can compulsorily also have different thicknesses, caused by the various processing steps.

Fig. 14 shows the view into the hollow space formed by the cover 10.7, which is used as a receiver for the end of a motor vehicle exhaust pipe, from the direction of the front face 15.

Finally, a portion of the crimped circular end 17 is represented in an enlarged scale in Fig. 15.